(2) the particles which penetrate obstacles with singularly penetrating power; and (3) the ordinary X-rays. X-rays are waves in the ether, not light, something of that nature; the penetrating rays are electrons which are shot off. But the most interesting are the first rays, those which are easily stopped; for these turn out to be atoms of matter shot off with a speed comparable to that of light. It is the first time that matter has ever been known to have such a speed as that. Rutherford, now of Montreal, has measured for the first time the speed of these readily stopped absorbable particles, and also their mass. He shows that they are atoms of matter, and that they are moving with one-tenth of the velocity of light.

All hot bodies and all negatively charged bodies are now believed to be giving off these particles; radio-activity is becoming quite a common feature. Recently fallen rain drops are radio-active, leaves of plants and most things in sunshine are radio-active; the difficulty will be to find something which is not radio-active in some degree, and the commonest kind of radio-activity appears to be the detachment of an electron. Loose charges seem to fly off, apparently by centrifugal force or the jostling of the atoms.

The *size* of electrons is known, on the hypothesis that the atom of matter is composed of them, *i.e.* on the hypothesis that the inertia of matter is electrical, or that it is electrically composed of the inertia of these charges. Evidence of this is accumulating, and there is reason to believe, not only on philosophical grounds, but in accordance with direct physical experiment, that electric inertia is the only inertia that exists. The size of an electron can then easily be determined. Regard the radius as unknown, the charge as known, the mass as known; then the size is at once calculable. The size of these electrons is about one hundred thousandth part of the diameter of an atom, otherwise they would not have sufficient inertia. They are the smallest bodies known. There was a time when the atom felt small; it is not big, it is true, but it is getting to feel quite a large thing beside the electron. To illustrate the difference between an atom and an electron, imagine an electron to be the size of a full-stop as here printed, and an atom a church 160 feet long, 80 feet broad and 40 feet high—in an atom of hydrogen there are nearly 1000 electrons—imagine those thousand full-stops thrown into that church, and some idea will be obtained of the relative sizes of the electron and the atom. The electrons *occupy* the atom very effectively; they are energetic and pushful, though not big. They occupy the atom in the sense that soldiers occupy a country, that is, they will not let anybody else in. The electrons, by the force they exert, will not let anything else in, they make the atom impenetrable; they also give the atom its other properties and enable it to act chemically. That chemical affinity is electrical force has been known for a long time; it was suspected by Sir Humphrey Davy. I believe if the atom has no extra or odd electron it has no chemical force; the atom may have molecular force, which is cohesion, and this point might be explained at greater length; for in my ideas cohesion is turning out to be electrical too, though not in the sense of attraction between ordinary positive and negative electricity.

The relation of the electron to the atom is a matter of the most intense interest. But it is not to be supposed that the electron is stationary in the atom. The electrons are revolving round one another at tremendous speed, so that the atom is a region of intense activity. The electrons are not in the least crowded, although there are a thousand in the hydrogen atom, twenty or thirty thousand in the sodium atom and one hundred thousand in the mercury atom; for consider how far apart are they in proportion to their size. Just as far apart as planets in the solar system are in proportion to their size. The distance of the earth from the sun is to the size of the earth very much as the distance of electrons from each other is to their size in a mercury or platinum atom. The fact is, we come to an atomic astronomy, and the atom is becoming like a solar system, or like nebulæ or Saturn's rings or something of that kind, composed of a number of small particles in a violent state of revolving motion and occupying very little of the whole space with their actual substance. They are so small that collisions are infrequent; so it is in the solar system and heavens generally, collisions do occur, but seldom, because of the excessively small sizes compared with the distances at which they are spaced out.

Taking any family belonging to a sun, *i.e.* a solar system, it forms something like the same kind of collection as the electrons form in an atom. So when we get in an atom a sort of solar system we begin to question whether there is anything in absolute size at all. It is a question I cannot answer. It has been suggested that solar systems may be atoms of a still larger universe. These are questions that are too hard. But there appears to be no end to the infinity of the universe, and all that we can say is that the probability is that it is infinite in an infinite number of ways.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The subject for the Adams prize essay of 1905 is "Wave Motion of Finite Amplitude and Unchanging Type, in Deep Water." The prize is open to the competition of all who have at any time graduated in the University. The value of the prize is about 225*l*. Further particulars are given in the *University Reporter* for March 10.

The new Lucasian professor will next term lecture on "The Theory of Gases and the Molecular Statistics of Energy."

Dr. Anningson and Prof. Woodhead will represent the University at the congress of the Royal Institute of Public Health to be held in Liverpool next July.

IT is reported through Reuter's Agency that a sum of more than 200,000*l*. has been given to Barnard College, New York, to be used for the purchase of the land adjoining the buildings. The name of the donor is not given.

A JUBILEE of the University of Heidelberg will be held next August in commemoration of the revival of the University in 1803 by Charles Frederick of Baden. Though the *fêtes* will be on a more modest scale than those which marked the celebration in 1886, an extensive programme is being arranged for the occasion.

THE London School of Tropical Medicine announces that the Craggs research prize of 50*l*. will be awarded in October to a past or present student of the school who, during the current year, has made the most valuable contribution to tropical medicine. Full information may be obtained from the medical tutor at the school, Royal Albert Docks, London.

THE senate of the Madras University has passed a resolution, it is reported in the *Pioneer Mail*, disapproving of the recommendations of the Indian Universities Commission that the system of examinations by compartments should be abandoned. The Vice-Chancellor of the Bombay University at the recent annual convocation advocated the establishment of a science school, and urged the raising of a fund of twenty lakhs of rupees for the purpose. Part of this money, he said, must come from the public and part ought to be provided from the funds for higher education in the Presidency. He thought the Government might be trusted to provide the remainder.

THE will of Dr. H. E. Schunck, F.R.S., who died on January 13, shows that he bequeathed to Owens College in trust for the foundation of a "Dr. Schunck's Endowment for Promoting Chemical Research," the contents of his laboratory and the apparatus, appliances and instruments, to be administered by the principal and professors of chemistry in Owens College and by two other trustees, to be nominated by the council, and by his son, Mr. C. A. Schunck, if he shall be willing to serve. The endowment is for the purpose, not only of research in chemical science, but also of geological, physiological and other sciences, and reports are to be annually presented to the council of the college.

IN the House of Commons on Monday Mr. Brodrick stated that many of the recommendations of the Military Education Committee are to be accepted. The new Director-General of Military Education and Training is to have an advisory board as suggested by the Committee. This body is to consist of the heads of Woolwich, Sandhurst, the Staff College, and the Ordnance College, of two representatives

of the Universities, a representative selected by the Incorporated Association of Headmasters, another selected by the Headmasters' Conference, another by the Royal Society, and two members nominated by the Secretary of State. The settlement of the syllabus of examination will be left in their hands. There is to be one and the same examination for Woolwich and Sandhurst for the Army and for the Militia. For University candidates, whom Mr. Brodrick is anxious to encourage, a scheme has been prepared which will enable them to enter the Army on equal terms with other candidates. A student will have to pass Moderations at Oxford or some equivalent examination at another University before he is twenty, and he will also have to do six weeks' training with a Regular unit at Aldershot or elsewhere. He will then be given a provisional commission. Before he is twenty-two he will have to take honours at the University and to go through another six weeks' training. He will then receive a commission dating back two years. The Universities are to be asked to include in their honours examination two or three military subjects—*e.g.* military topography and military history.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 22.—"Characteristics of Electric Earth-current Disturbances and their Origin." By J. E. **Taylor.** Communicated by Sir Oliver Lodge, F.R.S.

The paper deals with disturbing effects, produced by rapidly varying earth-currents, on a telephone receiver, connected in a short line of telegraph having both ends earthed in the sea. The sounds produced have certain well-marked characteristics. In these latitudes they are always stronger and of more frequent occurrence in summer than in winter. They are daily in evidence for a few hours at, or about, the time of sunset, *i.e.* whilst daylight is fading. In general they do not evidence themselves to any great extent during broad daylight, but are readily precipitated by a state of electrical tension in the atmosphere which may culminate in a thunderstorm, and rarely fail to herald the approach of a storm or gale.

Particularly noticeable among the various types of disturbance enumerated, there are some which resemble the distant scream of a rocket rising in the air. These commence with a shrill whistle, and die away in a note of diminishing pitch. They vary in intensity, but always have a similar duration of from two to four seconds, are freely heard at night, and only occasionally during the day. The sound is characteristic of an initial high velocity rapidly damped and dissipated. This type of disturbance is assumed to be produced by the passage of meteoric bodies in sufficient proximity to the circuit, which set up rapidly intermittent electrical discharges in the upper regions of the atmosphere, inducing electric currents in the sea which affect the circuit. That they are only occasionally heard during broad daylight is explained by the ionisation of the upper atmosphere by solar radiations, possibly electronic, which interposes a conducting screen. A high state of electrical tension in the atmosphere nullifies or modifies the conductivity produced. At nightfall solar radiations cease to act, and conductivity disappears gradually. The nightfall disturbances are accounted for by aërial electric currents associated with the disappearance of ionic conductivity, the effects of these aerial currents becoming perceptible so soon as the conductivity becomes sufficiently small to act no longer as a screen. It is suggested that similar causes influence the diurnal variations of the earth's magnetic field, and that the changes of ionisation of the atmosphere offer a reasonable explanation of the greater night-time efficiency in signalling recently observed by Mr. Marconi in experiments with Hertzian wireless telegraphy.

"Some Dielectric Properties of Solid Glycerine." By Ernest **Wilson**, Professor of Electrical Engineering, King's College, London. Communicated by Sir William Preece, K.C.B., F.R.S.

February 12.—"The Brain of the Archæoceti." By Dr. G. Elliot **Smith.** Communicated by Prof. G. B. Howes, F.R.S.

"Primitive Knot and Early Gastrulation Cavity Coexisting with Independent Primitive Streak in Ornithorhynchus." By Prof. J. T. **Wilson** and Dr. J. P. **Hill.** Communicated by Prof. G. B. Howes, F.R.S.

Linnean Society, February 19.—Prof S. H. Vines, F.R.S., president, in the chair.—Mr. John **Clayton,** of Bradford, presented a set of thirty-two photographs to illustrate the celebrated Cowthorpe Oak, near Wetherby, Yorkshire. The author concludes that the age of the tree has been greatly over-estimated, his own belief being that 500 years is the extreme limit of its age, from sapling to its present decrepitude and decay.—Dr. George **Henderson** offered some remarks on the possible uses of essential oils in the economy of plant-life. Adverting to the well-known fact that moisture in the air prevents radiation and consequent loss of heat, he suggested that emanations of essential oil from plants might possibly prevent damage by night frost during the period of flowering, basing his suggestion on Prof. Tyndall's researches thirty-two years since, on the presence of infinitesimal quantities of essential oil in the air. Tyndall found such presence increased the absorptive power of the air as regards heat-rays: taking dry air as 1, air saturated with moisture as 72, then traces of essential oil rank as follows:—Rosemary 74, cassia 109, spikenard 355 and aniseed 372. Dr. Henderson brought these remarks before the meeting as an interesting question for botanic investigation, since essential oils are usually regarded as mere waste products.—The Rev. T. R. R. Stebbing, vice-president, having taken the chair, the first paper, on the electric pulsation accompanying automatic movements in *Desmodium gyrans,* by Prof. J. C. **Bose,** was summarised by the president for the author. In this paper Prof. Bose gives the results of his investigation of the question as to whether or not spontaneous movements are accompanied by an electric disturbance comparable to that resulting from external stimulation. Spontaneous movements are not uncommon in the higher plants, but for various reasons there are but few instances suitable for an investigation of this kind. The most striking case is that of *Desmodium gyrans,* the telegraph-plant. The leaf of this plant is trifoliolate, consisting of two small lateral leaflets and a larger terminal leaflet. The lateral leaflets move up and down, like the arms of a semaphore—whence the popular name of the plant—the period of a complete up and down movement, in the plants observed, being about 3½ minutes. Having placed one electrode on the petiolule of a leaflet and the other on the petiole of the leaf, both in connection with a galvanometer, Prof. Bose found that the spontaneous movement is associated with an electrical disturbance of a peculiar kind. There is first a large principal wave of disturbance, followed by a smaller subsidiary wave, the period of the former being about 1 minute, that of the latter about 2½ minutes. This disturbance is the expression of a "current of action" travelling in the plant from the excitable petiolule to the resting petiole.—A paper by Miss A. L. **Embleton,** communicated by Prof. G. B. Howes, was read by Mr. A. D. Michael for the author, on *Cerataphis Lataniae,* a peculiar Aphid. This insect was observed in 1901 on various orchids in the Cambridge University Botanic Garden. The author gives the detailed synonymy of the creature, which is well known to cultivators on the Continent, and proceeds to set out its life-history; in this country it exists in only one form, reproduced parthenogenetically, corresponding to an aleurodiform stage of a migratory Aphis. The author concludes by suggesting that it is one of the migratory Aphides which has been deprived of its usual series of metamorphoses owing to an artificial mode of life.—On specialisation of parasitism in the Erysiphaceæ, by Mr. E. S. **Salmon.** The author began by explaining the term "biologic form" or "species" by instancing two fungi which were not distinguishable morphologically, acting in diverse fashion on the same host-plants. This phenomenon has been known in the Uredineæ for some time, but its discovery in the Erysiphaceæ was more recent.

Royal Microscopical Society, February 18.—Dr. Henry Woodward, F.R.S., president, in the chair.—Dr. Arthur **Rowe** gave a demonstration on the photomicrography of opaque objects as applied to the delineation of the minute structure of chalk fossils. Dr. Rowe said the photomicro-